Uncertainties in the SAFRAN 50-year atmospheric reanalysis over France

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Long-term retrospective meteorological datasets at high spatial and temporal resolution are of critical use in regional climate change assessment. SAFRAN is a gauge-based analysis system that combines atmospheric profiles from ECMWF global scale reanalyses with ground observations to provide time series of seven variables—solid and liquid precipitation, air temperature, specific humidity, wind speed, visible and infrared radiation—for climatically homogenous zones. Within the CLIMSEC[1] project, SAFRAN has here been applied over France to build a 50-year meteorological dataset with a 8 km spatial resolution (Vidal et al., in press). This study focuses on the uncertainties identified in this long-term reanalysis.

Several tests were conducted in order to investigate three different sources of uncertainty. The intrinsic uncertainty of the analysis system, due to the spatial and temporal interpolation steps, is first assessed over the whole period 1958-2008 by comparing SAFRAN outputs with observations at 83 high-quality validation stations included in the analysis (dependent data). The second source of uncertainty is related to the significance of the ground network density and its evolution over the 50-year period. This type of uncertainty has been studied throughout three experiments: (1) four years sampling the rise in available observations were selected for running the SAFRAN analysis after having discarded observations from the validation stations (independent data); (2) the SAFRAN analysis has been run again for a recent year by considering only stations available in the early 1960s; and (3) the analysis was finally run for the same recent year by considering no ground observation at all. The last studied source of uncertainty results from the non-homogeneity in time series of surface observations and is here assessed by comparing long-term trends computed from reanalysis outputs and from homogenized time series.

Results first show that SAFRAN intrinsic bias and error are relatively low and fairly constant over the 50-year period. The dramatic rise in the number of observations that occurred in the 1990s results in a large decrease of the uncertainty between the late 1950s and the early 2000s for all variables expect precipitation for which a dense network of observations was already available at the beginning of the period. Large-scale information only appears not to be sufficient for adequately representing spatial patterns of visible and infrared radiation and wind speed fields. Adding observations from stations available in the early 1960s improves significantly the results for all variables except visible radiation and wind speed, whose field correlation remain low. Finally, trend estimates from the SAFRAN reanalysis compare well to homogenized series for precipitation, but show very scattered values for minimum and maximum temperature that are not found in trends from homogenized series.

Vidal, J.-P., Martin, E., Baillon, M., Franchistéguy, L., and Soubeyroux, J.-M. (in press). A 50-year high-resolution atmospheric reanalysis over France with the Safran system, *Int. J. Clim.*

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